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ABSTRACT

An investigation of worry and emotionality as different components of test anxiety is presented through a longitudinal study of subjects in grades 6 and 9. The study aimed at describing and explaining the development of school-related anxiety, dissatisfaction and the perceived learning environment. By confirmatory factor analysis with boys and girls independently, the separation of worry and emotionality as test anxiety components proved successful. The Test Anxiety Inventory (TAI), a self-report scale designed to measure individual differences in test anxiety as a situation-specific trait, was used in the study. The instrument proved to be promising as a reliable and content valid measure to assess cognitive and emotional facets of dispositional situation-specific test anxiety. (Author/GK)

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Ralf Schwarzer

Worry and Emotionality as Separate Components in Test Anxiety

The assessment of test anxiety has been influenced by certain theoretical advances in this field during the last decade. The cognitive orientation in psychology has lead to more insight into the process of anxious arousal in evaluative situations. I. Sarason (1960, 1975) suggested that stress elicits a tendency to worry about possible failure and to direct more attention to self-related thoughts. The direction of attention hypothesis claims that highly test-anxious individuals turn their task-relevant cognitions into task-irrelevant cognitions as soon as the situation is appraised as threatful (Wine 1971, 1980). In test situations the evaluation of one's performance can be appraised as a threat to self-esteem. Highly test-anxious individuals are concerned with possible failure and self-doubts (Heckhausen 1980). They worry about their performance and direct their attention to the self as actor instead of to the task at hand. This cognitive component of state test anxiety is responsible for the debilitating effect of anxiety on academic achievement. Autonomous arousal on the other hand seems to be less important in affecting the outcome in evaluative situations.

Measures of test anxiety often do not measure exactly what their name denotes. Cognitive and emotional components of anxiety are confounded. Therefore it is hard to demonstrate the specific achievement debilitating impact that is due to the cognitive component only. Nicholls (1976) has shown that some of the items of the Test Anxiety Scale for Children (TASC) can be clustered together as a homogeneous subset which measures poor self-evaluation. This is in line with the suggestion of Liebert and Morris (1967) who see test anxiety as composed by worry and emotionality. The worry component refers to cognitions which include concerns about performance, poor self-evaluation, and consequences of failure. The worrying individual does not feel confident about his competence, thinks how much brighter others are, and perceives himself as more vulnerable toward failure. These cognitions are represented by worry items, whereas emotionality items refer to affective-physiological arousal which is experienced by the person in evaluative situations. Emotionality is not the arousal itself but the subjective perceptio of such internal events. Emotionality items include the beat of the heart, the upset stomach, nervous feelings, uneasiness and so on. Measures designed to assess worry and emotionality are reported by Morris and Liebert (1970), Spielberger et al. (1978, 1980) and Deffenbacher (1980).

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In a review of the literature Deffenbacher (1980) concludes that the worry-emotionality distinction has been proved useful in psychological research during the last decade. The separation of these two components has to been seen relatively because they are not orthogonal. The author reports correlation coefficients between r=.55 and r=.76, indicating a moderate to high relationship between worry and emotionality that can be seen as a compromise of convergent and discriminant validity. From a theretical point of view the components should assess different facets of anxiety, that is, they should be correlated. On the other hand this correlation should not be too high in order to detect validly the cognitive vs. emotional mechanisms in state anxiety. The covariation should be less than what is usual between congeneric tests. In several studies Deffenbacher (1980,116) has determined the correlation between academic performance and the two aspects of anxiety. The coefficients linking achievement and emotionality were from .07 to .26, the coefficients linking achievement and worry from .26 to .36. This different relationship is consistent with the theory and lends confirmation to previous studies. More important is the stability of these relationships. By partial correlation analyses it could be shown that worry stayed to be correlated with performance when emotionality was partialed out. Worry consistently formed a negative relationship with test performance whereas the findings for emotionality were rather inconsistent. The author also reports some moderator effects of the cognitive component. At low levels of worry for example, emotionality did not debilitate test performance, but at high levels of worry it did. The reverse was true in another study. Further research is needed to clarify the contradictions of such findings.

The above mentioned empirical results support the assumption that in evaluative situations highly test-anxious individuals direct their attention partly away from the task toward self-related topics which in turn leads to a debilitating effect on intellectual performance. The opposite assumption that autonomous arousal is primarily responsible for a disorganized activity seems to be without sufficient empirical confirmation. But a remark of caution is necessary. Emotionality and physiological arousal do not mean the same construct. Emotionality is the perception of experienced arousal by the individual, that is subjective arousal which is only moderately correlated with objective arousal. Morris and Liebert (1970) found a correlation of r=.34 for this relationship. This has to be considered in interpreting findings based on self-reported worry and emotionality.

Another point is the limitation of most findings to state anxiety, not trait anxiety. The concept of worry and emotionality has been originally formulated with respect to test anxiety as a state. Deffenbacher (1980,124) concludes that, although both components separate out as elements of state anxiety, they may cluster together as elements of trait anxiety. Fortunately, the research of some other authors focusses now on worry and emotionality as components of trait anxiety too. Spielberger et al. (1978) have developed a new instrument called Test Anxiety Inventory (TAI) that allows for a total score as well as two separate scores indicating worry and emotionality."... it is not possible to classify the test anxiety scales definitely as either measures of A-Trait or A-State, but the bulk of the evidence is consistent nevertheless with the assumption that test anxiety is a situation-specific measure of anxiety proneness (A-Trait) in test situations" (Spielberger et al. 1978, 186). The correlation between the two components was r=.71 for males and r=.64 for females, which can be seen as a desirable relationship. Hodapp (1980) has used a German translation of the TAI in a study with 134 students in grade 7. He reports a correlation between worry and emotionality of r=.42 for males and r=.46 for females. He also reanalysed some data from Spielberger and found a relationship of r=.65 for males and r=.56 for females. The author applied causal analysis techniques to his data and detected very interesting complex linkages with A-State, A-Trait and achievement. Worry was connected with A-Trait (.47), A-State was predetermined by A-Trait (.34), worry (.18) and emotionality (.24). Achievement was predetermined by intelligence (.33), worry (-.27) and not by emotionality (.02). This is in line with previous results. The worry and emotionality subscales seem to work as separate measures of dispositions indicating a situation-specific tendency to be concerned with one's own performance and to be aware of one's own physiological arousal.

Method

Instrument

In our study we used the Test Anxiety Inventory (TAI). The TAI is a recently developed self-report scale that was designed to measure individual differences in test anxiety as a situation-specific trait (Spielberger 1980). It consists of 20 items which are to be responded by using a four-point rating-scale format. In addition to a total score, separate scores for worry and emotionality can be obtained. There are two 8-item subscales for this purpose. The scales are internally consistent which is demonstrated by median alphas of .89 and .80, respectively. Spielberger and his collaborators have separated

the two components by exploratory factor analysis using varimax rotation. The 8 items of the worry subscale had higher loadings on the worry factor compared to their loadings on the emotionality factor. The reverse was true for the emotionality items.

The German version, which was developed by Hodapp, Laux & Schaffner (1979), is still a preliminary version.[1] It is designed to assess the two components that are represented by 10 worry items and also 10 emotionality items. One aim of our study is to validate this instrument by finding an empirical solution which yields clear-cut subscales for worry and emotionality. The German authors have already conducted some studies with large samples and they report positive findings concerning factor structure and internal consistencies (not yet published). The authors prefer oblique rotation within an exploratory factor analysis approach whereas we prefer confirmatory factor analysis. This difference in statistical approach makes is worthwhile to report our findings.

Data Collection and Sample

The context of our investigation is a longitudinal study with 2000 subjects which is aimed at describing and explaining the development of school-related anxiety, dissatisfaction and the perceived learning environment. For the second point in time, in September and October 1980, we enriched our instruments by adding the TAI to the other variables. We are in need for a separate worry measure that could help to explain the growing tendency of evaluation anxiety, helplessness, and self-doubt in some subsamples. The instruments were given to 1,848 students until now, attending grades 6 and 9. 763 males and 811 females had no missing values and serve as independent samples in the present context. The data were collected during school lessons in 4 types of school, representing different levels of academic achievement. The data were first analysed for females only, leaving the males as a sample for replication purposes.

Analyses

The most sophisticated method today which can be used to describe an explicit set of theoretically relevant dimensions is confirmatory factor analysis (Bentler 1980, Jöreskog & Sörbom 1978,1979, Kenny 1979). This is a kind of

[1] I am grateful to the authors for having the opportunity to use their preliminary version 4 A of the German TAI

multivariate analysis with latent variables using structural equations. It is not used as a data exploration method but as a hypothesis-testing method. The dimensions are defined in advance with respect to theoretical reasons and previous empirical results. In our study, worry and emotionality are defined as latent variables which are linked each with a set of 10 congeneric items. Every item is defined as an observed variable containing two kinds of variance, common variance by a causal dimension and error variance due to unmeasured and unknown factors. The model can be specified in different ways depending on the hypotheses. For our problem it was necessary to allow for a correlation between the two factors. On the other hand, the errors of the observed variables were not allowed to correlate with each other. Each item was specified as having one loading. This implies that the corresponding loading on the other factor has to be zero. The main question in confirmatory factor analysis is whether the model fits the data. There are two indications to answer this question. A chi-square value informs about goodness of fit. Unfortunately, with large samples this value almost never leads to a good fit. The problem is discussed by Bentler (1980, 428). The LISREL IV program, which we used, delivers another indication of goodness of fit, that is the matrix of residuals. It informs about the precision of the reproduced correlation coefficients compared to the input matrix. A rule of thumb says, there should be no residual coefficient greater than .10. If the fit is satisfying the attention can be directed to the parameter estimates. LISREL yields maximum likelihood estimates of the factor loadings and all other parameters that are specified as free, for example the inter-correlation of the two dimensions. To summarize, our first aim is to find a model with a satisfying fit to our data. This would mean a confirmation of the hypothesized separation of worry and emotionality. The result can be compared to a single factor solution that should have a worse goodness of fit. Second, we want to learn about the parameter estimates, that is the factor loadings as well as the correlation between the two latent variables. Finally, the same procedure with the valid model is conducted with the replication sample.

There are many studies in test anxiety using exploratory factor analysis. For reasons of comparison and familiarity our final set of items has to undergo an exploratory factor analysis with varimax rotation.[2] An accepted LISREL solution should correspond with a clear pattern in this kind of analysis. In addition, some further information can be obtained (eigenvalues, sampling adequacy).

[2] JFACTOR program with maximum likelihood estimation (available in SPSS)

The third method that is applied to demonstrate the separation of worry and emotionality is smallest space analysis (SSA1).[3] This is a nonmetrical technique of multidimensional scaling. The results are depicted in a space diagram which informs about the distances of each item from the centroid and the distances of all items to each other within a 2-dimensional framework. A coefficient of alienation serves as indication of goodness of fit. It should be smaller than .15.

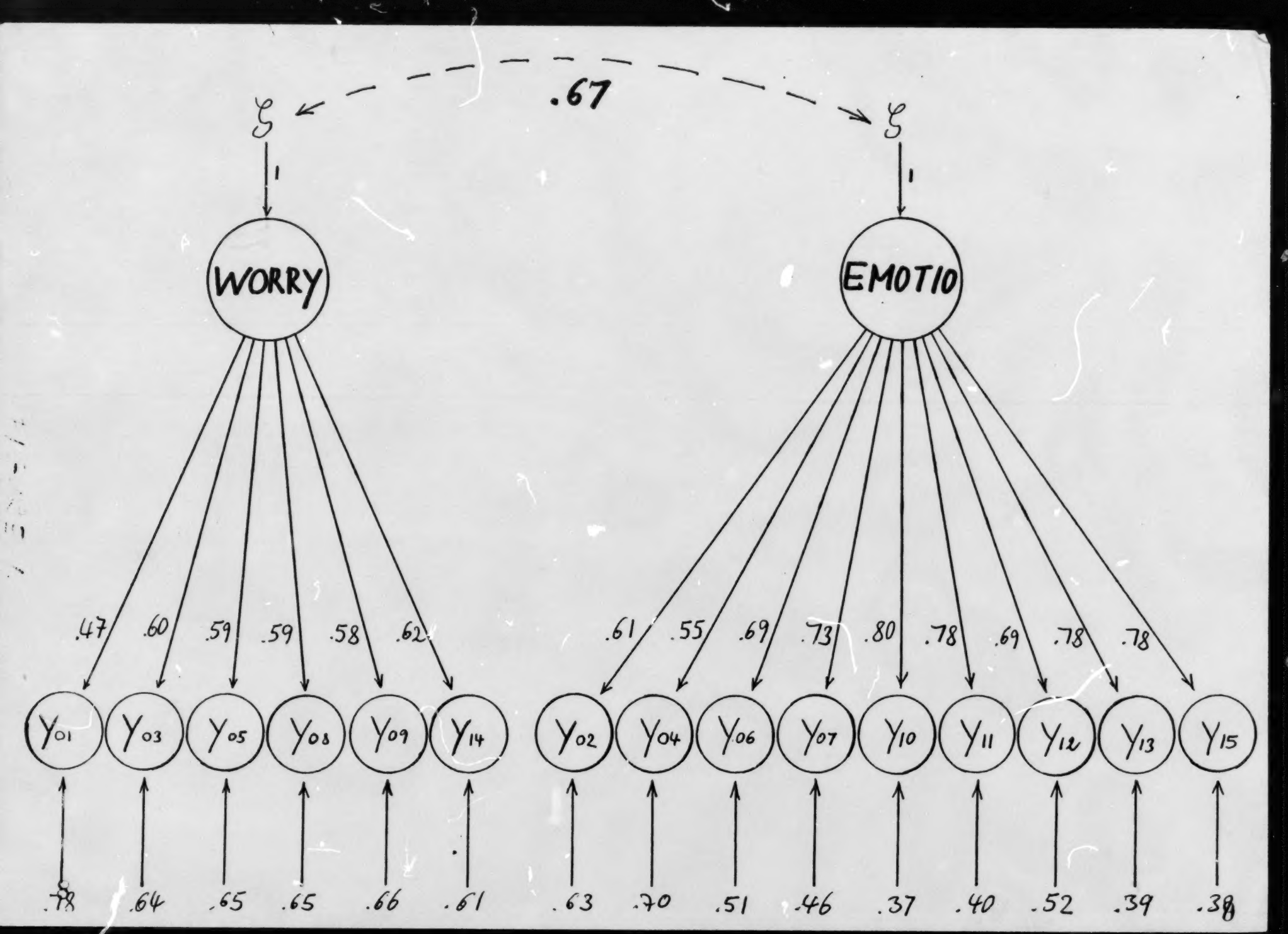
These steps are completed by a traditional item analysis. If all four approache give meaningful consensus information we can conclude that there are two reliable dimensions within test anxiety as a situation-specific trait.

Results

Confirmatory Factor Analysis

The first analysis with 10 items for each factor has not been satisfying. The next step was done after eliminating one item on each factor. This 18-item solution yielded a satisfying fit but was unfortunately connected with a correlation of .85 between worry and emotionality as latent variables. The mistake was to eliminate typical extremely located worry and emotionality items and to leave a pool which contained some mixed items measuring worry as well as emotionality. Two nearly parallel scales had been created by this mistake. Finally, after eliminating four worry items and one emotionality item we found a satisfying 15-item solution. The final chi-square value of 244.7 with 89 df was still too high ($p = .00$) dependent on the large sample ($N = 811$). With $N = 100$ the χ^2 would have beed 29.9 ($p = 1.00$) which even would lead to an overfit. More important when using large samples is the matrix of residuals that is the difference between the input correlation matrix and the matrix of the reproduced correlations. Out of 105 coefficients only two exceeded the .10 limit. Therefore we accept this solution. A single factor model did not fit the data. This was detected by fixing the correlation between the two latent variables to PSI (2,1) =1 which resulted in a much higher χ^2 of 71,6 (for $N = 100$), resp. $\chi^2 = 585.7$ ($N = 811$, $df = 90$). The difference between the chi-square values was highly significant. The model specification and the parameter estimates are depicted in figure 1. As can be seen, worry and emotionality factors correlate .67. The loadings are sufficient and meaningful. They are lower for worry connected with more error variance for this dimension.

[3] SSA1 program (available in SPSS). All procedures were calculated at the computer center of the Technical University Aachen RWTH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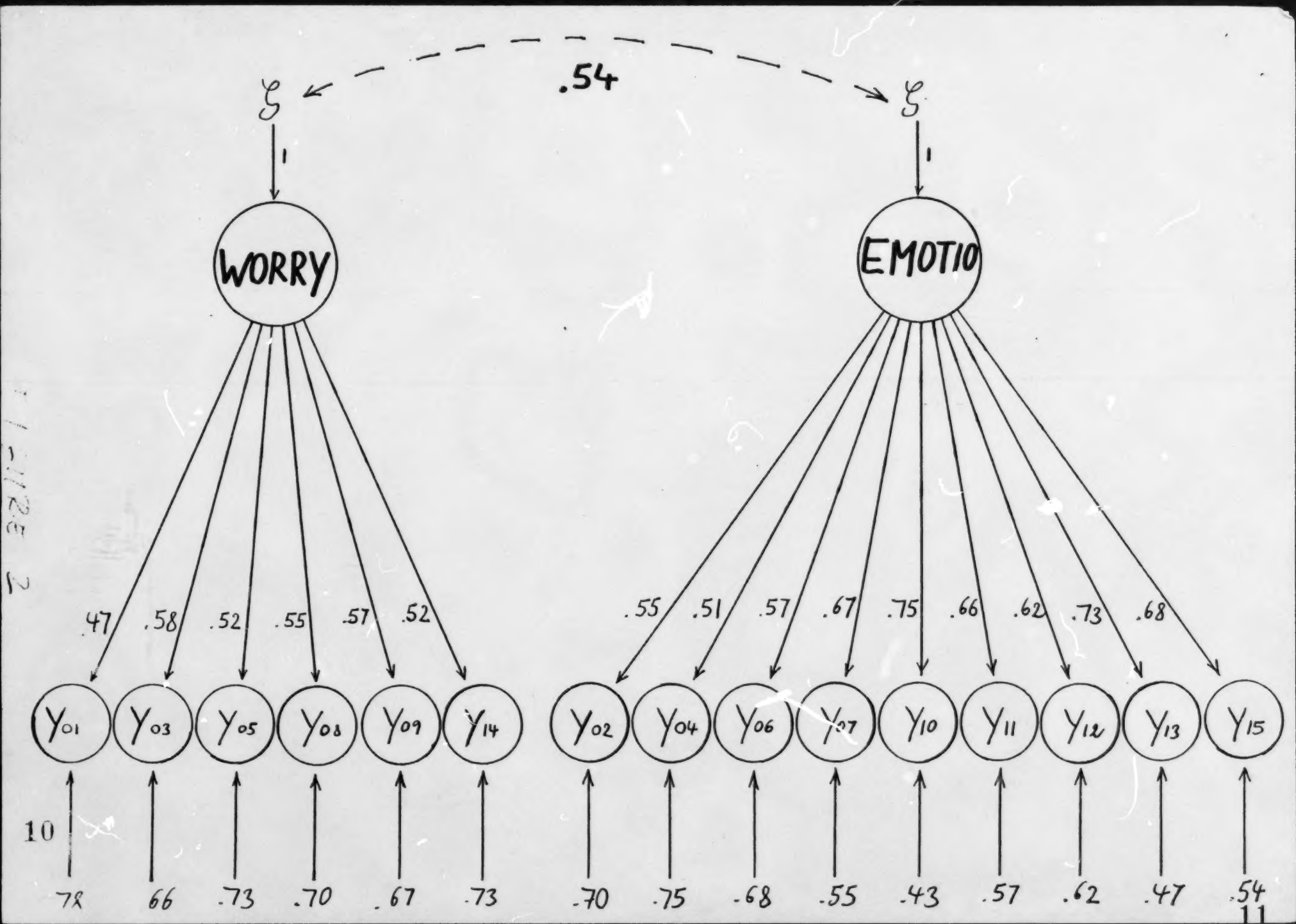
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The final model was also applied to the replication sample of males. Again, a chi-square value of 217with 89 df was too high (p = .00) , due to the sample size of N = 763. With N = 100 the χ^2 would have been 28.2 (p = 1.00). The reproduced correlation matrix was satisfying. Only four out of 105 residuals exceeded the .10 limit. Therefore the model is successfully replicate

The parameter estimates are depicted in figure 2. Worry and emotionality dimensions are correlated moderately (.54). This is a remarkable difference to the girls. The factor ladings, too, are lower than for the original sample. This is connected with a lower amount of explained variance. In our model the squared loadings are identical to the communalities. The average of the communalities is the explained variance (see tables 1 and 2).
The two subsamples show differences in several parameters. The accepted 15-item model does not work with boys the same way as with girls. This is a point for further research. Sex differences in general have to be taken into account. But the formal replication of the specified model was successful. Only this is our concern in the present context.

Exploratory Factor Analysis

As a second step, in order to provide with comparable and familiar information, we have calculated a maximum likelihood factor analysis with varimax rotation. The measure of sampling adequacy was above .90 for both samples. The results for the girls are summarized in table 1. Only two eigenvalues are greater than 1. 45 % of the total variance is due to the factors, 38 % to emotionality and 7 % to worry. The correct loadings for worry vary from .45 to .63, the loadings for emotionality vary from .53 to .75. They are similar to the LISREL estimates There is no doubt about the factor structure. Each high loading is exactly located on the dimension towhich it belongs theoretically. This is illustrated by figure 3. The six worry items cluster together, and the 9 emotionality items do even better so.
The results for the boys are summarized in table 2. Only two eigenvalues are greater than 1. 37 % of the total variance is due to the factors, 29 % to emotionality and 8 % to worry. The correct loadings for worry vary from .45 to .58, the loadings for emotionality from .51 to .71 which is similar to the LISREL estimates. Again, each high loading is precisely located where it has to be. This is illustrated by figure 4. Worry and emotionality turn out to represent separate clusters.

Table 1: Results of exploratory factor analysis compared to confirmatory factor analysis in the original sample of girls (N = 811)

Variable Number	EXPLORATORY FA			CONFIRMATORY FA		
	WORRY	EMO	h^2	WORRY	EMO	h^2
1	.45	.16	.23	.47		.22
2	.18	.59	.38		.61	.37
3	.50	.28	.33	.60		.36
4	.16	.53	.31		.55	.30
5	.48	.30	.32	.59		.35
6	.29	.63	.48		.69	.48
7	.29	.67	.54		.73	.54
8	.63	.13	.41	.59		.35
9	.63	.12	.41	.58		.34
10	.26	.75	.63		.80	.63
11	.23	.74	.61		.78	.54
12	.20	.66	.48		.69	.48
13	.27	.73	.61		.78	.61
14	.53	.30	.37	.62		.39
15	.27	.74	.61		.78	.61
EIGENVALUE	1.57	6.26				
VARIANCE	6.6 %	38.2 %	44.8 %			

Table 2 : Results of exploratory factor analysis compared to confirmatory factor analysis in the replication sample of boys (N = 763)

Variable Number	EXPLORATORY FA			CONFIRMATORY FA		
	WORRY	EMO	h^2	WORRY	EMO	h^2
1	.52	.03	.27	.47		.22
2	.18	.52	.30		.55	.30
3	.56	.17	.34	.58		.34
4	.07	.51	.27		.51	.26
5	.45	.25	.26	.52		.27
6	.28	.51	.33		.57	.32
7	.22	.63	.45		.67	.45
8	.53	.13	.29	.55		.30
9	.58	.12	.35	.57		.33
10	.23	.71	.56		.75	.57
11	.08	.67	.46		.66	.43
12	.10	.62	.39		.62	.38
13	.21	.70	.54		.73	.53
14	.47	.20	.26	.52		.27
15	.21	.64	.46		.68	.46
EIGENVALUE	1.13	4.41				
VARIANCE	7.5 %	29.4 %	36.9 %			

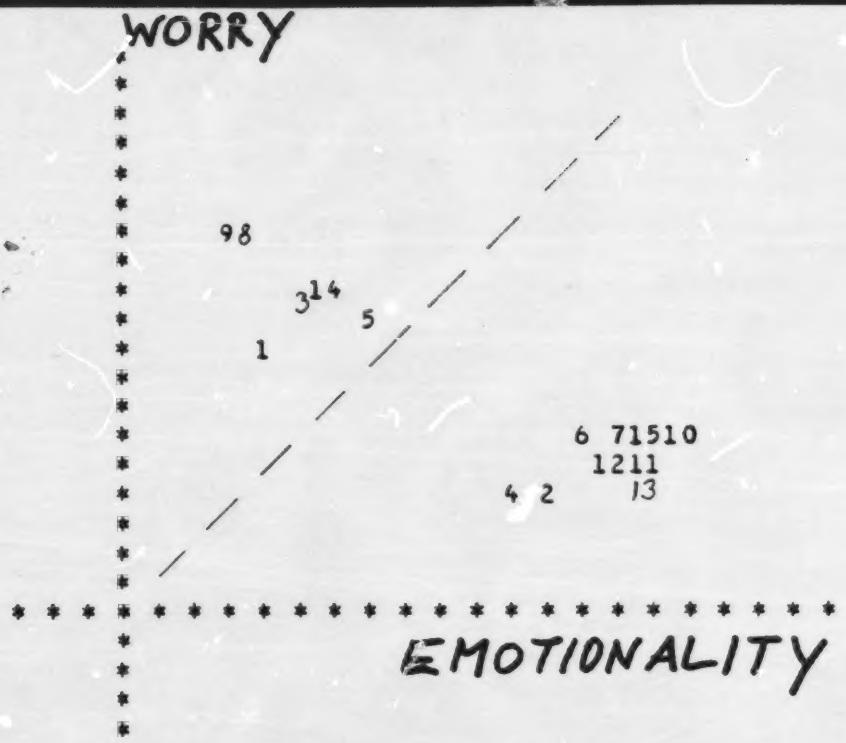

Figure 3 : Varimax-rotated factor structure for the female sample

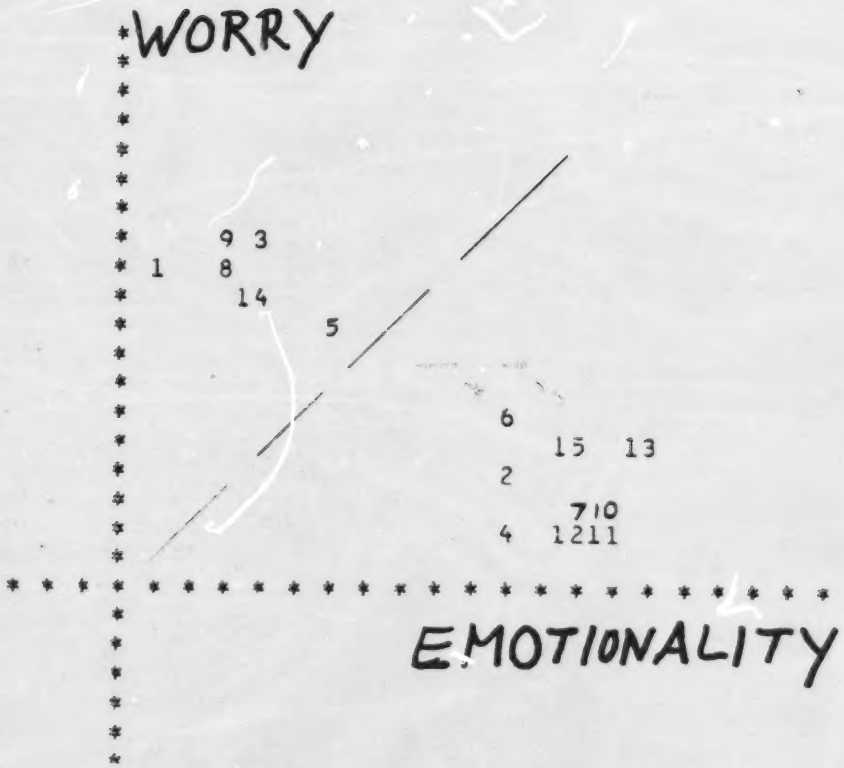

Figure 4 : Varimax-rotated factor structure for the male sample

Smallest Space Analysis

Nonmetrical twodimensional scaling yielded results that are in line with the above reported findings. For girls the coefficient of alienation (.13) indicates a satisfying goodness of fit. The space diagram illustrates the successful separation of worry and emotionality items (figure 5).

For boys the coefficient of alienation is .12. The space diagram shows a high degree of similarity to the girls for the horizontal axis (figure 6). In both diagrams the emotionality items are more homogeneous. They cluster together whereas the worry items display a more heterogeneous pattern.

Item Analysis

Finally, a traditional item analysis was performed yielding sufficient internal consistencies for emotionality (.91 for girls, .86 for boys) but rather low alphas for worry (.75 for girls, .71 for boys), a fact that may be also due to the reduced number of items. Overall, there is no corrected item-total correlation coefficient lower than .40 (cf. table 3).

Conclusion

The separation of worry and emotionality as different components of test anxiety has been proven successful. By confirmatory factor analysis with girls and boys independently, worry was linked to 6 items, emotionality to 9 items consistently. The two dimensions were correlated .67 in the female sample, and .54 in the male sample. Traditional factor analysis, smallest space analysis and item analysis have been able to confirm and enrich the findings. The emotionality dimension turned out to be more substantial. It exhausts a greater amount of total variance, shows considerably low error terms, clusters nicely together and is internally very consistent. This is especially true for girls.

On the whole, the instrument can now be used as a reliable and content valid measure to assess cognitive and emotional facets of dispositional situation--specific test anxiety. But it is still possible to improve the worry subscale. There is empirical evidence that this dimension could be improved by adding more items which may be similar to the present item pool. This could lead to a greater amount of explained variance, to higher factor loadings, to a less heterogeneous clustering and to a strengthened internal consistency. The TAI is a very promising instrument. We are sure that it will have a significant impact on test anxiety research in Germany, too.

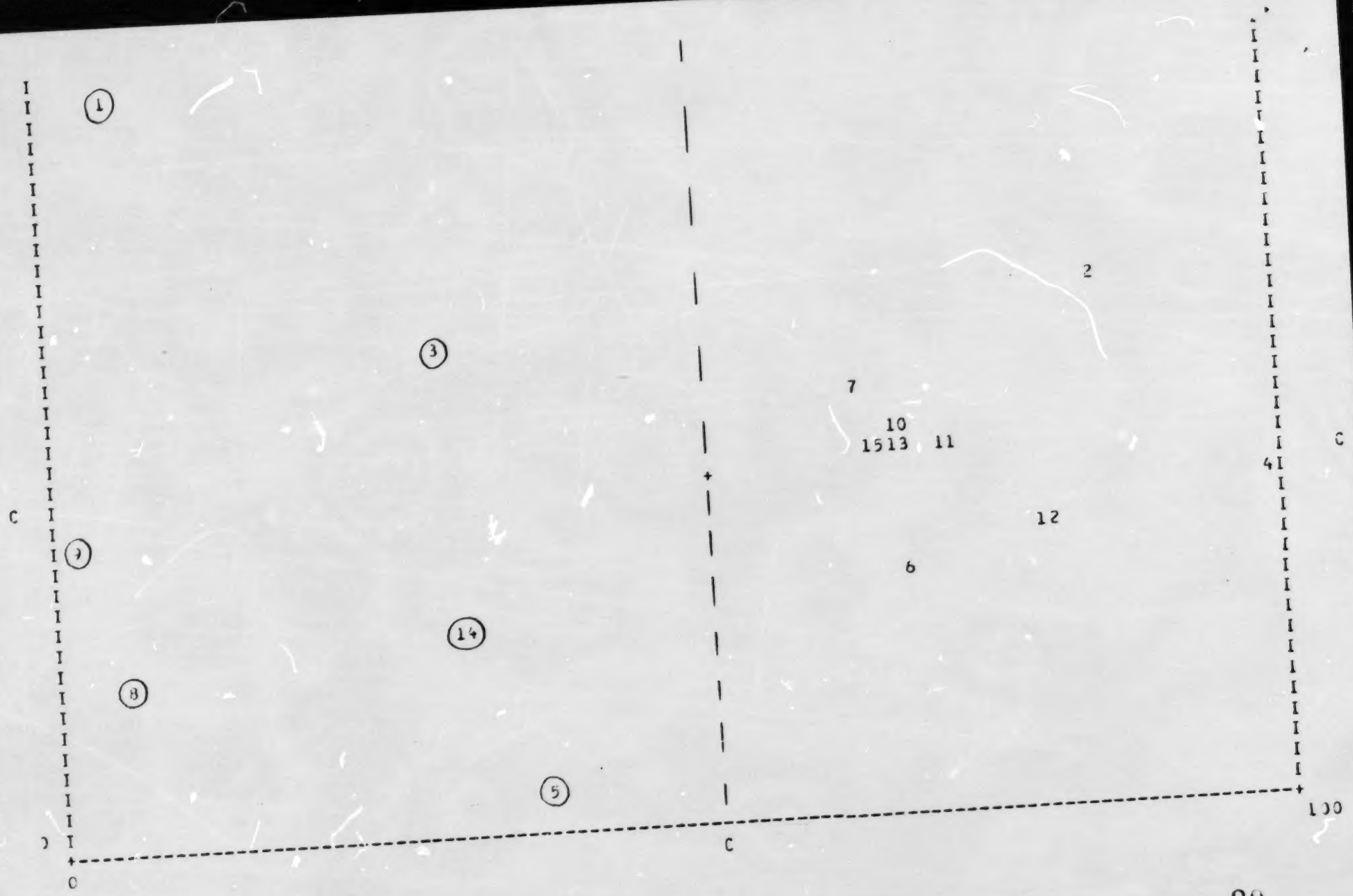

FIGURE 5

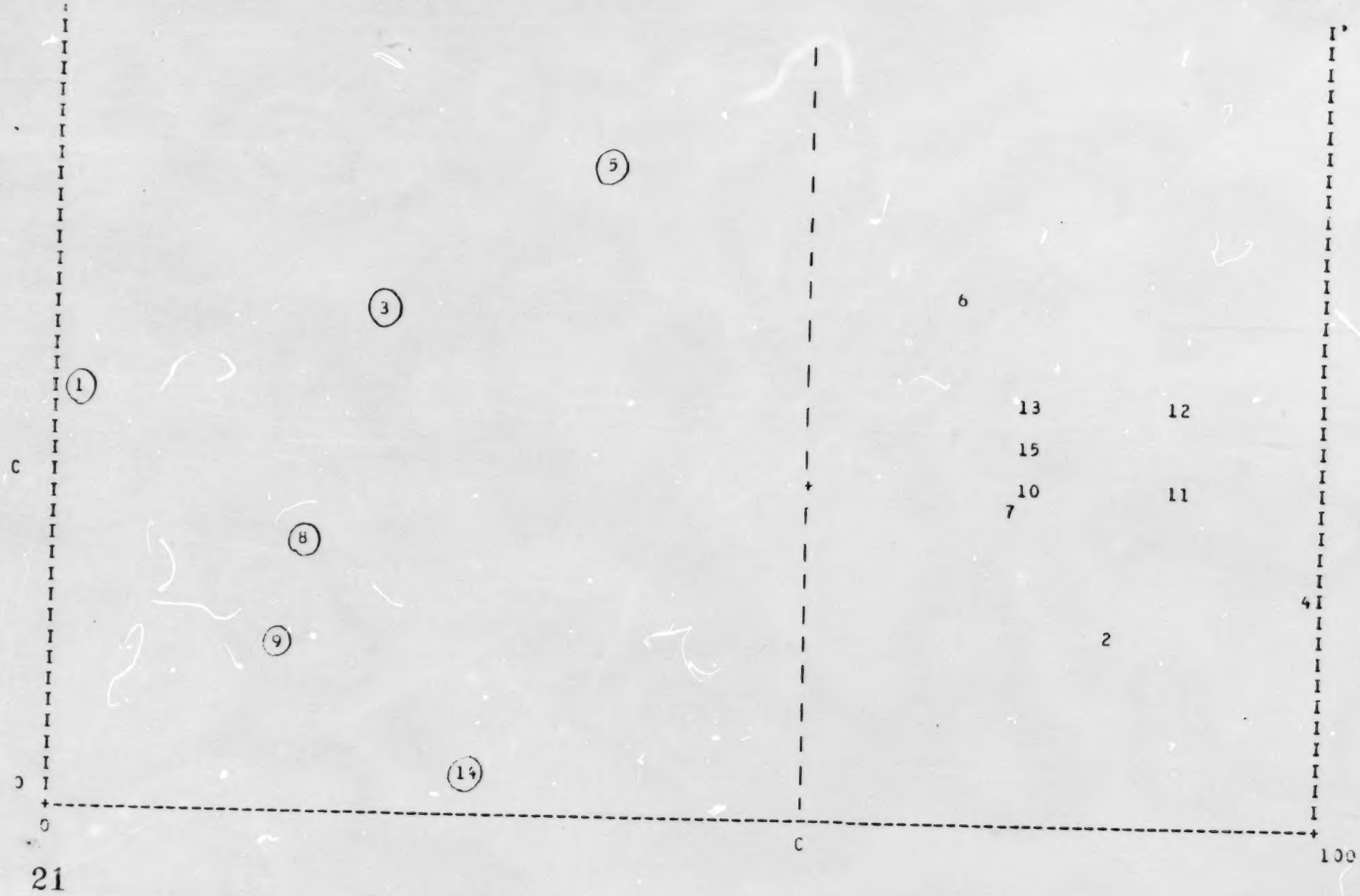

FIGURE 6

Table 3: Item analysis of the worry and the emotionality subscales for females and males

Number of Item	Variable	WORRY				EMOTIONALITY			
		GIRLS		BOYS		GIRLS		BOYS	
		$\bar{x}$	r_{it}	$\bar{x}$	r_{it}	$\bar{x}$	r_{it}	$\bar{x}$	r_{it}
02	1	2.86	.40	2.72	.40				
03	2					1.55	.59	1.45	.51
05	3	2.29	.51	2.28	.46				
06	4					1.33	.53	1.31	.48
08	5	2.07	.48	2.11	.41				
12	6					1.83	.66	1.67	.51
13	7					2.27	.70	1.92	.62
14	8	2.12	.52	2.11	.47				
15	9	2.52	.52	2.43	.48				
16	10					1.84	.76	1.58	.68
18	11					1.61	.75	1.48	.61
21	12					1.55	.66	1.44	.58
24	13					1.70	.75	1.57	.68
25	14	2.46	.50	2.46	.44				
27	15					1.87	.75	1.64	.64
Cronbach's Alpha		.75		.71		.91		.86	

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